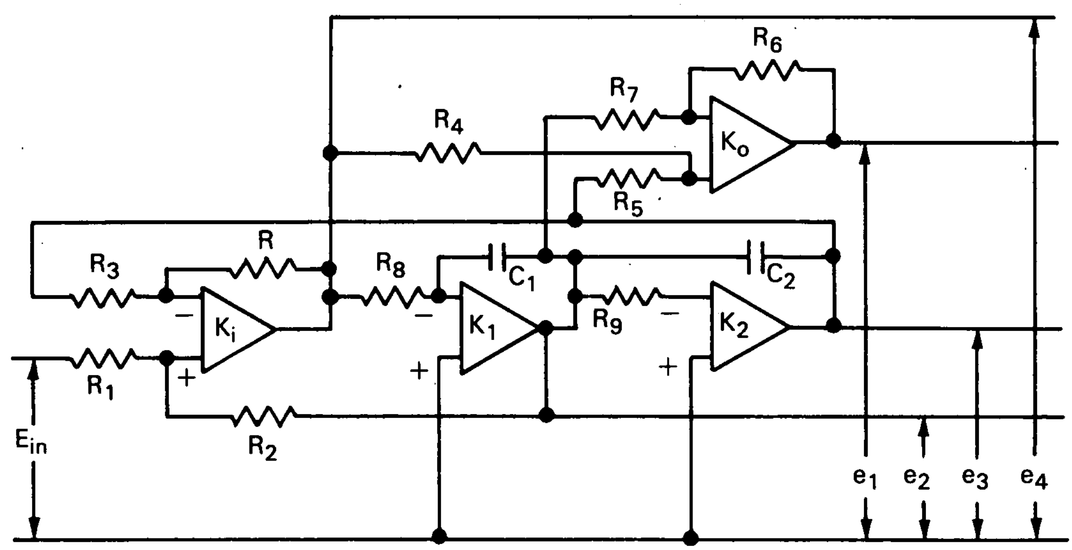
NASA TECH BRIEF

Active RC Networks of Low Sensitivity for Integrated Circuit Transfer Function Synthesis



The lack of suitable inductive components for integrated circuit construction requires that other techniques be developed. Most methods of active RC filter synthesis are unsuited to high Q performance due to the extreme system sensitivity to change in the passive or the active components.

The network configuration shown is capable of extremely high Q performance with exceptional stability (insensitivity). In addition, the zeros and poles are independently adjustable. (The zeros may be located anywhere in the complex frequency plane and the poles anywhere in the left half-plane.) This network produces 2 poles and 2 finite zeros that can be arranged to produce a second order low pass, high pass, or bandpass function as desired. In addition, all functions are available simultaneously. Higher order functions are obtained by direct cascade connection of these building blocks. The frequency of maximum response and the Q are adjustable using a single resistor, R for frequency adjustment, then a second resistor R_2 for Q adjustment.

The circuit consists of two integrators and two summers that are interconnected to produce a complete second-order numerator and a second-order denominator.

Calculation and experiment show that the system is extremely insensitive to changes in both the active and passive components.

To place the zeros in the right half-plane, the signal from the first integrator, K_1, is inverted. The output

(continued overleaf)

summer K_0, can then be eliminated as all inputs to it have the same polarity; however, it is convenient to use the output summer for isolation.

The sum of the sensitivities to the first four resistors, R, R_1, R_2, R_3 is *zero,* and all sensitivities are independent of Q. The sensitivity to changes in R_8 and C_1 will be zero if the R_8C_1 product remains fixed, as will the frequency sensitivity. In addition, the frequency sensitivity to R_9 and C_2 will be zero if the R_9C_2 product is held constant.

Note:

Complete details of this circuit are contained in: *State-Variable Synthesis for Insensitive Integrated Circuit Transfer Functions,* by W. J. Kerwin, L. P. Huelsman, and R. W. Newcomb, Solid State Circuits Journal of the IEEE, September 1967. Copies of this article are available from:

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Patent status:

No patent action is contemplated by NASA.

Source: W. J. Kerwin, L. P. Huelsman, and R. W. Newcomb
(ARC-10146)